

SECTION 32 13 13

CONCRETE PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Materials and accessories.
- B. Preparation of subgrade, subbase, or base.
- C. Formwork.
- D. Placing concrete reinforcement.
- E. Placing concrete.
- F. Joints.
- G. Finishing.
- H. Curing and protection.
- I. Installation of joint seals.
- J. Field quality control.

1.02 RELATED SECTIONS

- A. Preparation of subgrade to proper grade for concrete, including compaction, is specified in Section 31 00 00 - Earthwork.
- B. Preparation of subbase and base, where required, is specified in Section 32 11 17 - Aggregate Subbase Courses, and Section 32 11 23 - Aggregate Base Courses, respectively.
- C. Portland cement concrete curbs and gutters are specified in Section 32 16 21 - Concrete Curbs, Gutters, and Walks.
- D. Portland cement concrete, concrete reinforcement, and various materials, services, and incidentals pertaining thereto shall conform with Section 03 20 00 - Concrete Reinforcing, Section 03 15 00 - Concrete Accessories, Section 03 30 00 - Cast-In-Place Concrete, Section 03 05 15 - Portland Cement Concrete, and Section 03 35 00 - Concrete Finishing.

1.03 MEASUREMENT AND PAYMENT

- A. General: Measurement and payment for portland cement concrete paving will be either by the lump-sum method or by the unit-price method as determined by the listing of the bid item for portland cement concrete paving indicated in the Bid Schedule of the Bid Form.

- B. Lump sum: If the Bid Schedule indicates a lump sum for portland cement concrete paving, the lump-sum method of measurement and payment will be in accordance with Section 01 20 00 - Price and Payment Procedures, Article 1.03.
- C. Unit Price: If the Bid Schedule indicates a unit price for portland cement concrete paving, the unit-price method of measurement and payment will be as follows:
 - 1. Measurement:
 - a. Portland cement concrete pavement will be measured for payment by the square yard for each specified class of concrete and thickness.
 - b. Reinforcing steel, dowels, and tie bars will be measured separately for payment as specified in Section 03 20 00 - Concrete Reinforcing.
 - c. Subgrade paper, transverse expansion joints, weakened-plane joints, and joints sawed within 5 feet of volunteer cracks, longitudinal and transverse construction joints, and longitudinal weakened-plane joints will not be measured separately for payment, and all costs in connection therewith will be considered included in the measurement of portland cement concrete pavement.
 - 2. Payment: Portland cement concrete paving will be paid for at the indicated Contract unit prices for the computed quantities as determined by the measurement Method specified in Article 1.03.C.1.

1.04 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M81 Cut-Back Asphalt (Rapid-Curing Type)
- B. American Concrete Institute (ACI):
 - 1. ACI 117 Standard Tolerances for Concrete Construction and Materials
 - 2. ACI 318 Building Code Requirements for Reinforced Concrete
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 3. ASTM A663 Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
 - 4. ASTM C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens

5. ASTM C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
6. ASTM C496 Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
7. ASTM D2628 Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

D. Federal Specifications (FS):

1. UU-B-790 Building Paper, Vegetable Fiber, (Kraft, Waterproofed, Water Repellent, And Fire Resistant)

1.05 SUBMITTALS

- A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Product Data: Submit the respective manufacturer's product data for manufactured products.
- C. Shop Drawings:
 1. Submit drawings that indicate the locations of all joints in concrete, including construction joints, expansion joints, isolation joints, and weakened-plane or contraction joints.
 2. Submit drawings of reinforcing steel, tie bars, and connecting dowels. Comply with requirements specified in Section 03 20 00 - Concrete Reinforcing.

1.06 QUALITY ASSURANCE

- A. Tolerances: Comply with requirements of ACI 117, Section on Pavements.

PART 2 - PRODUCTS

2.01 FORMS

- A. Provide metal forms, weighing not less than 18 pounds per linear foot for pavement 8 inches thick, not less than 20 pounds per linear foot for pavement 9 inches thick, and not less than 22 pounds per linear foot for pavement 10 inches thick, and in no case less than 7/32 inch thick.
- B. Provide side forms having a depth equal to the prescribed edge thickness of the pavement, without horizontal joints.
- C. Provide forms having a base not less than 8 inches wide and a flanged tread or top surface not less than 2 inches wide. For multiple lanes, provide base width at least equal to height.

- D. Provide forms not less than 10 feet long except where shorter forms are necessary for curves. Use metal keyway forms for the full length of roadway form to which attached. Provide wood bulkheads for the full width of pavement lane equipped with keyway form.
- E. Provide holes for bars and dowel assemblies where required.
- F. Provide at least three stake pockets to accommodate a 1 inch diameter stake in each section of form 10 feet or more in length, and at least two such pockets in each section of form less than 10 feet long.
- G. Provide each section of form with a positive locking device that will secure it tightly to the adjoining section.
- H. Provide forms free from warp and of sufficient strength to resist, without visible springing or settlement, all loads applied in the paving process.

2.02 MATERIALS AND ACCESSORIES

- A. Concrete Reinforcement: Refer to Section 03 20 00 - Concrete Reinforcing, for requirements.
- B. Portland Cement Concrete: Refer to Section 03 05 15 - Portland Cement Concrete, for requirements. Provide class of concrete as indicated on the Contract Drawings.
- C. Liquid Asphalt: AASHTO M81, cut-back asphalt, rapid-curing type.
- D. Subgrade Paper: Kraft laminated building paper with bituminous binder, reinforced, meeting requirements of FS UU-B-790.
- E. Benches and Chairs: ACI 318.
- F. Tie Bars: ASTM A615, Grade 60, of type and size indicated.
- G. Dowels: Plain round bars meeting requirements of ASTM A615, Grade 60, or ASTM A663, Grade 80, epoxy-coated bars, furnished with approved snug-fitting ASTM A53 galvanized pipe sleeve. Provide sleeve with one end closed.
- H. Expansion-Joint Filler: ASTM D2628, preformed elastomeric joint seal.
- I. Joint Sealing Compound: Refer to Section 03 15 00 - Concrete Accessories, for requirements.
- J. Concrete Curing Compound: ASTM C309, Type 1.

PART 3 - EXECUTION

3.01 PREPARATION OF SUBGRADE, SUBBASE, OR BASE

- A. Immediately prior to placing forms, condition and trim subgrade, subbase, or base to exact shape, grade, and cross section required by the Contract Drawings. Condition and shape to indicated width between side forms plus not less than one extra foot on each side.

- B. Use of a subgrade machine of approved type is permitted, in which case place forms in advance of exact conditioning and trimming, to permit use of the machine.
- C. Where the crown is to be warped or sloped to conform to contour of intersecting streets, storm water inlets, and other intersecting contoured surfaces, shape subgrade to required depth and cross section by means of hand tools and other equipment as approved by the Engineer. In addition:
 - 1. Drive grade stakes to proper elevation in the subgrade at 6-foot intervals in both directions.
 - 2. Compact subgrade by rolling at least 1 foot wider on each side than the concrete.
 - 3. Finish concrete in such locations by means of floats, shovels, spades, or other approved hand tools, operated so as to consolidate the concrete without segregation.
- D. Deposit any excess material obtained from such preparations upon adjacent shoulders or as required.
- E. Prepare subbase, if required, as specified in Section 32 11 17 - Aggregate Subbase Courses.
- F. Prepare base, if required, as specified in Section 32 11 23 - Aggregate Base Course.

3.02 FORMWORK

- A. Obtain written approval from the Engineer of the subgrade, subbase, or base prior to placing forms and impervious compacted subgrade.
- B. Place subgrade paper where indicated.
- C. Do not use built-up forms. Remove forms with battered top surfaces, distorted faces or bases, and forms that are deformed or broken in any way; and, if straightened and repaired, do not reuse until they have been inspected and approved in writing by the Engineer.
- D. Do not use forms showing a variation of more than 1/8 inch in a 10-foot length from the plane of the top or face when tested with a straightedge.
- E. Join forms neatly and tightly and stake securely with stakes in every pocket. Drive up fully all locking devices at form joints so as to produce a smooth fitting, rigid joint.
- F. Maintain proper grade and alignment under all working conditions. Maintain base of forms directly in contact with the finished subgrade, base, or subbase.
- G. Building of pedestals of earth or other materials upon which to rest forms in order to bring them to the required grades will not be permitted.
- H. Clean and coat forms with form release compound before concrete is placed against them, each time they are used.
- I. Do not remove forms from freshly placed concrete until the concrete has set for 12 hours.

3.03 PLACING CONCRETE REINFORCEMENT

- A. When reinforcement is indicated, provide deformed bars, welded wire fabric, or prefabricated welded or clipped deformed bar mats, as indicated on the Contract Drawings, and of size and quantity indicated.
- B. Place reinforcement so that the extreme longitudinal member will be located not more than 3 inches from the sides of the slab section, and extend the end of all longitudinal members to within 2 inches of the ends of slab sections.
- C. Lap adjacent sheets of welded wire fabric and welded or clipped mats not less than 12 inches when the lap is made at right angles to the centerline of the pavement and where wire fabric sheets are permitted to be lapped parallel to the centerline.
- D. Wrap the wire fabric or bar mats together with wire at all laps, at intervals not exceeding 24 inches.
- E. Reinforce multiple lane construction with bar mats or sheets of welded wire fabric of same weight and size as though the paving were constructed in single lane widths. Install mats or sheets so as to leave an unreinforced longitudinal gap 6 inches wide, parallel to and centered on the lane lines.
- F. Place tied bars or prefabricated bar-mat reinforcement securely supported on approved chairs as specified in Section 03 20 00, Concrete Reinforcing, and ACI 318. Install reinforcement in place on supports on the subgrade for a distance ahead of the paver equal to at least 500 feet or a two-hour run of the paver, whichever is greatest, before any paving is begun. Stop paving and install a bulkheaded construction joint whenever the paver comes to within 100 feet of the end of such steel placement. Secure reinforcement against displacement during concrete placement.
- G. Tie Bars and Dowels:
 - 1. Uniformly place all tie bars and dowel assemblies at the indicated depth below finished surface on 4-foot centers or other dimensions where indicated otherwise on the Contract Drawings.
 - 2. In all of the above methods of reinforcement placement, install dowel bar assemblies and secure in place in metal chairs on the subgrade, ahead of the placement of the slab reinforcement and concrete.
 - 3. Support tie bars for weakened-plane joints on metal chairs and securely fasten prior to placing concrete, or place on top of the freshly poured concrete and vibrate to position at proper depth. Install tie bars in such manner that upon initial set of the concrete they will be at proper alignment, depth and spacing, and at right angles to the designated line of cut.
 - 4. Place tie bars for construction joints on metal chairs, or machine place, in such a manner that upon the initial set of the concrete, they will be at proper alignment, depth, and spacing, and at right angles to the formed edge of the joint.

3.04 PLACING CONCRETE

- A. Notify the Engineer at least 24 hours in advance of placing concrete.

- B. In the event completion of concrete placement during darkness should become necessary, provide a lighting system adequate to illuminate all concrete-placement operations.
- C. An interval of more than 45 minutes between placing of two consecutive concrete batches will be cause for stopping paving operations. Should this occur, place a bulkhead with construction joint keyway.
- D. Place concrete while fresh. Retempering of concrete will not be not permitted.
- E. Do not chute concrete directly on to subgrade or subbase from any type of hauling unit without written permission from the Engineer.
- F. Place concrete pavement in full traffic lane widths, separated by construction joints; or if approved, the concrete pavement may be placed monolithically, two or more traffic lanes wide without a construction joint, but with a longitudinal weakened-plane joint at each traffic lane line.
- G. Deposit concrete in successive batches on the subgrade or subbase to full width of traffic lane and strike off with an approved screed-type finishing machine.
- H. When constructing adjacent traffic lanes, the wheels of the finishing machine that rest on previously completed concrete shall be flat, without flanges, and the inside edge of the tread of the wheels shall not operate so close to edge of slab as to cause spalling or damage. The tread of the wheels shall not be less than 3-inches in width. The wheels on the opposite side, that operate on the steel side forms, shall have flanges on both sides.
- I. Use a mechanical spreader of an approved type, designed to move the volume of freshly deposited concrete transversely.
- J. Use concrete already placed in adjacent traffic lane, curb, or gutter as the form for new concrete placed adjacent thereto, but not until the concrete placed in the first lane has attained a split tensile strength of at least 300 pounds per square inch, as determined by ASTM C496.
- K. Consolidate concrete by means of suitable vibrating screed, internal vibrator, or other approved vibratory equipment such that the concrete is effectively consolidated without segregation. Maintain amplitude of vibration such that the vibrations are perceptible on the surface of the concrete at least one foot from the vibrating equipment. Provide a device for measuring and indicating the actual frequency of vibrations.
- L. Perform screeding and tamping by making one complete pass over the entire area of the pavement. Adjust the tamper to produce the proper tamping action and adjust screeds to an elevation slightly above finished grade, so that when properly consolidated and finished, the completed surface of the pavement will be at the required grade, true to cross section indicated, and free from laitance and porous areas.
- M. Concrete required to be placed in widths less than a normal traffic lane may be compacted and shaped by a powered mechanical compacting and shaping machine supplemented by hand methods as necessary. Deposit concrete as nearly as possible in its final position. Do not use vibrators for extensive shifting of masses of fresh concrete.

3.05 JOINTS

A. General:

1. Joints in pavement are designated as longitudinal and transverse construction joints, transverse expansion joints, and longitudinal and transverse weakened-plane joints.
2. Construct the faces of all joints normal to the finished surface of the road.
3. Construct transverse joints normal to the centerline of the road and extending full width of pavement. Construct similar types of transverse joints in line with each other across the full width of the pavement.
4. Construct longitudinal joints coincident with or parallel to the pavement centerline.
5. Install load transfer devices parallel to finished surface of the road.
6. Maintain finished surface of concrete in the same plane on both sides of a joint.

B. Construction Joints:

1. Construction joints shall be made when placing fresh concrete against hardened concrete at planned locations and elsewhere when concreting is interrupted for longer than 45 minutes.
2. Connect concrete on both sides of longitudinal construction joints with tie bars as indicated.
3. Do not place transverse construction joints within 10 feet of any other transverse joint. Should it become necessary to stop concreting for a period of time sufficient to require the installation of a bulkhead and construction joint within 10 feet of an existing transverse joint, remove and waste the concrete that has been placed beyond the existing joint.

C. Transverse Expansion Joints:

1. Form transverse expansion joints at indicated locations by means of preformed expansion joint filler. Support the joint strips in position by means of metal holders and end supports. Hold the supports firmly in position during concreting, and maintain them in place after completion of pavement.
2. Use metal holders fabricated of minimum 16-gage sheet steel in the form of a deep channel extending not less than 4 inches downward on both sides of the joint strip, slotted and cut away as necessary to allow the concrete to make close contact with the joint strip at close intervals. Spread ends of holders to admit the end supports.
3. During placement and consolidation of concrete, secure joint holder and end supports so as to prevent movement of the joint strip and to keep the top edge of the joint strip approximately 1/2 inch below the surface of finished pavement. After concrete has been placed and consolidated, the metal holder may be removed and a suitable metal channel substituted therefore; fit the channel snugly over the top edge of the joint strip and maintain it there until the joint is edged.

4. After side forms are removed, remove concrete that has flowed around the ends of the joint filler.

D. Weakened-Plane Joints:

1. Construct weakened-plane joints with a power concrete or masonry saw to a depth of not less than 2 inches and a width of 1/4 inch, plus or minus 1/16 inch. Produce clean cuts with sharp edges and no dislocation of coarse aggregate.
2. Saw weakened-plane joints not less than twelve hours nor more than twenty-four hours after placing concrete, unless otherwise approved by the Engineer. Conduct night operations if necessary to meet these time limits. Maintain a stand-by power concrete saw on the site at all times when paving operations are under way.
3. Do not saw where volunteer transverse cracks exist. If a volunteer transverse crack exists within 5 feet of a planned, sawed joint, omit the sawed joint, but do not omit more than three consecutive planned, sawed joints.
4. Restore curing compound disturbed by sawing operations. Conduct sawing operations in such a manner that the surface and edges of pavement will be unprotected for not more than 20 minutes.
5. At the Contractor's option, longitudinal weakened-plane joints at traffic lane lines in multilane monolithic concrete pavement may be formed by placing a continuous strip of plastic or other approved material that will not react adversely with the concrete. Use joint insert material of such width and character that, when placed vertically in the concrete, it will not bond with the concrete and will form an effective weakened-plane joint not less than 2 inches deep.
6. Insert the joint material with a mechanical device that places the material in a continuous strip, except where intervening structures break the continuity of paving. Splices in joint material will be permitted if splices are effective in maintaining the continuity of the joint material as placed.
7. Maintain top of joint material not more than 1/8 inch below finished surface of concrete. Do not deform joint material from a vertical position. Maintain alignment of finished joint parallel with center line of pavement, and free of local irregularities that exceed 1/2 inch, measured by a 12 foot straightedge, except for normal curvature of center line alignment.
8. Use a mechanical installation device to vibrate the concrete during placement of the strip, to cause the concrete to flow evenly about the joint material.
9. On completion of joint sawing, or on removal of the optional joint insert material, clean the joint and remove moisture by blowing with compressed air if necessary. Fill the joint with joint sealing compound in accordance with the manufacturer's instructions.

3.06 FINISHING

- A. Following placing of concrete, and after it has been screeded with a transverse finishing machine, screed longitudinally with a power-operated longitudinal finishing machine of an approved type. Work longitudinal screed cross-wise so as to level any irregularities in the surface.
- B. Following longitudinal screed, use an approved scraping strike off for removing any accumulation of excess mortar, laitance, or inert material from the surface.
- C. For the final finish, drag surface with a single full width strip of burlap to produce a uniform gritty texture on the surface. Keep burlap wet and periodically wash out to remove accumulations of mortar.
- D. After burlap dragging has been completed and concrete has taken its initial set, use an edging tool with 1/4 inch radius along each edge of the surface to prevent chipping of the edges in the removal of forms. Tool in same manner the longitudinal edge of any concrete surface adjoining previously placed pavement, to avoid subsequent spalling. Edge all joints at the same time, working from suitable bridges. Take particular care to keep surface of concrete in the same plane on both sides of each joint. Kneeling planks will not be permitted on the concrete surface.
- E. Where special circumstances require, hand float finishing may be substituted for a finishing machine, providing the following requirements are met:
 - 1. Use float of approved design and construction to provide a true floated surface.
 - 2. Operate each float from the side of the pavement and parallel to the centerline of the pavement.
 - 3. Use edge of float to cut down high areas. Float removed material into depressions until a true surface is obtained.
 - 4. On each successive passage of the float, slightly lap the previous path; and, upon completion of each passage, bring the float back and smooth the overlap between the two passages.
 - 5. Operate floats as far back of tamping machine as the concrete remains workable, with sufficient passes to remove perceptible irregularities.
 - 6. Maintain at least one spare float in good condition and available on the worksite at all times.

3.07 CURING AND PROTECTION

- A. Comply with the applicable requirements of Section 03 35 00 - Concrete Finishing, for curing concrete with liquid membrane-forming curing compound. Do not permit traffic on new concrete pavement until the concrete has attained its 28-day compressive strength as determined by strength tests in accordance with ASTM C39.

3.08 INSTALLATION OF JOINT SEALS

- A. Install joint fillers and sealing compounds where indicated in accordance with applicable requirements of Section 03 15 00 - Concrete Accessories.

3.09 FIELD QUALITY CONTROL

- A. Strength Tests: The Contractor shall perform strength tests of concrete as specified in Section 03 05 15 - Portland Cement Concrete.
- B. Thickness: After pavement is placed and cured, the Contractor shall take core samples at locations designated by the Engineer, for determination of actual thickness. A minimum of one core sample shall be obtained from each 100 feet of roadway for each lane.

END OF SECTION 32 13 13